**Waste to energy notes pdf**

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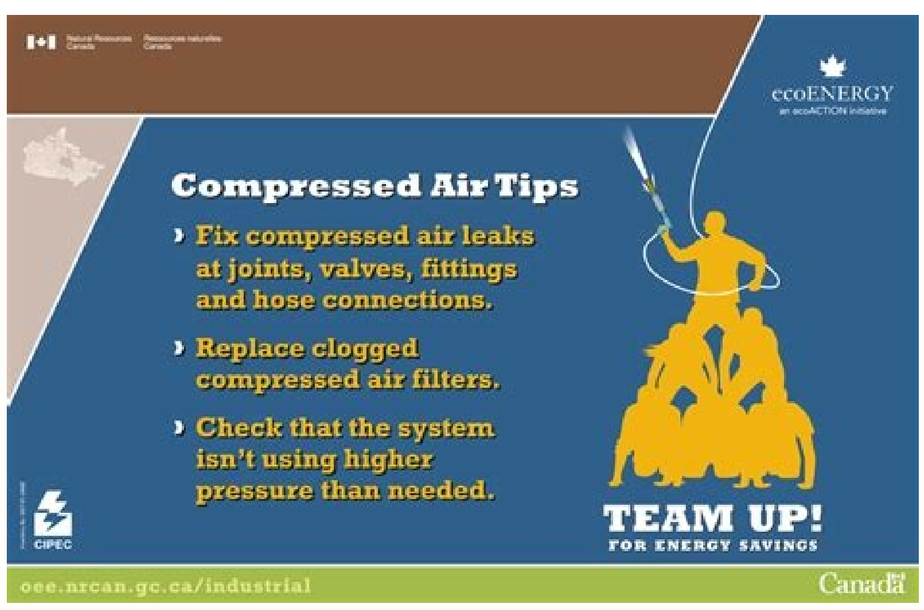



**Graphs in Uniformly Accelerated Motion along a straight line (a 0)**

x is a quadratic polynomial in terms of t. Hence x – t graph is a parabola.


**x-t graph**

v is a linear polynomial in terms of t. Hence v–t graph is a straight line of slope a.


**v-t graph**

a–t graph is a horizontal line because a is constant.


**a-t graph**

**Maxima & Minima**

$\frac{dy}{dx} = 0$ & $\frac{d}{dx}\left(\frac{dy}{dx}\right) < 0$ at maximum and $\frac{dy}{dx} = 0$ & $\frac{d}{dx}\left(\frac{dy}{dx}\right) > 0$ at minima.

**Equations of Motion (for constant acceleration)**

(a) $v = u + at$

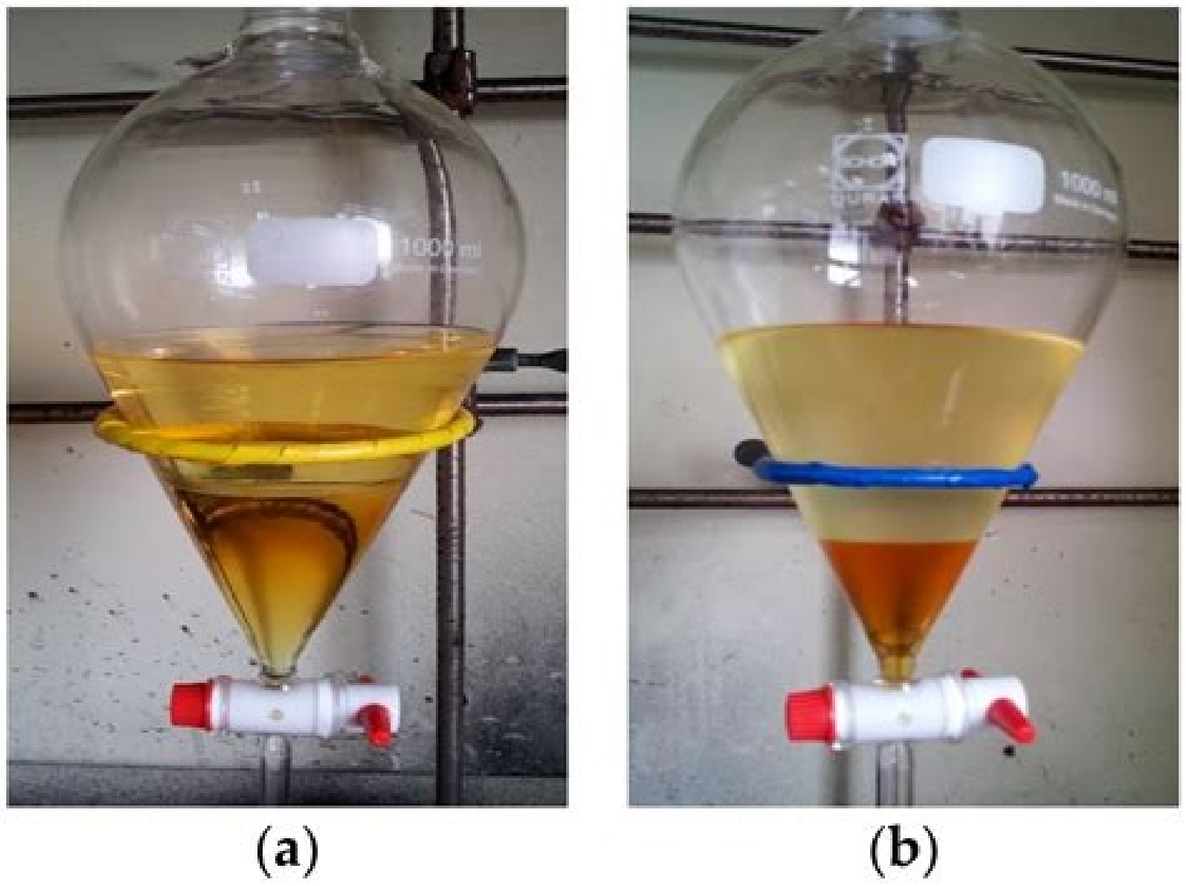
(b) $s = ut + \frac{1}{2}at^2$ $s = vt - \frac{1}{2}at^2$ $x_n = x + ut + \frac{1}{2}at^2$

(c) $v^2 = u^2 + 2as$

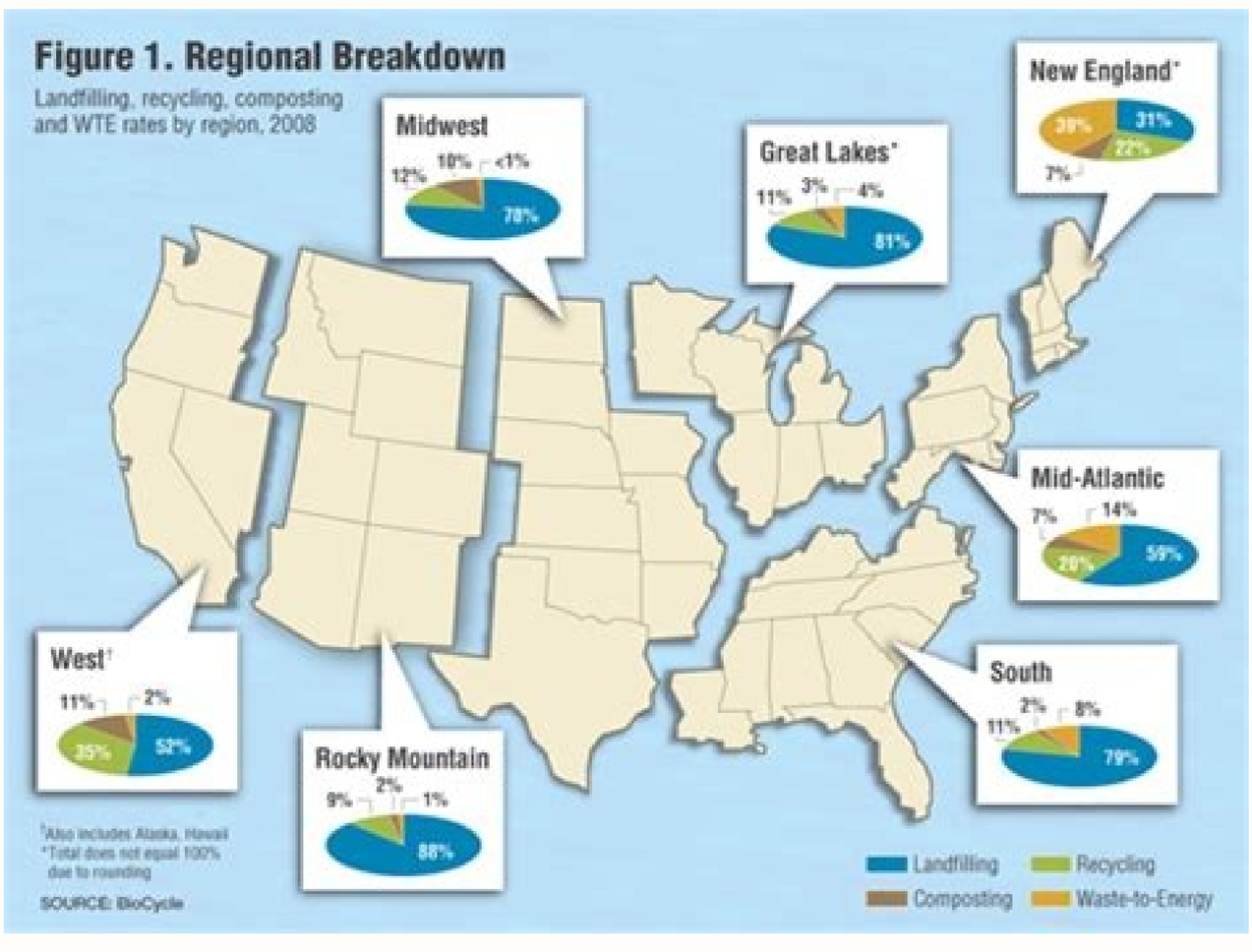
(d) $s = \frac{(u+v)}{2}t$

(e) $s_n = u + \frac{a}{2}(2n - 1)$

For freely falling bodies : (u = 0)



(a) (b)

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You're Reading a Free Preview Pages 7 to 17 are not shown in this preview. Bioenergy Technologies Office Wet waste, solid waste, and gaseous waste streams are potential high-impact resources for the domestic production of biofuels, bioproduct precursors, heat, and electricity. Wastes represent a significant and underutilized set of feedstocks for renewable fuel and product generation. These streams are available now without land-use change and in many cases their utilization helps to address the unique and local challenges of disposing of them. These resources are unlikely to diminish in volume in the near future, and as a result (in the short and medium term), they represent a potentially low-cost set of feedstocks that could help justify broader investment.The U.S. Department of Energy (DOE) Bioenergy Technologies Office (BETO) is interested in the area of converting waste-to-energy—specifically the potential of the following waste streams:Commercial, institutional, and residential food wastes, particularly those currently disposed of in landfills Biosolids, organic-rich aqueous streams, and sludges from municipal wastewater-treatment processes Manure slurries from concentrated livestock operations Organic wastes from industrial operations, including but not limited to food and beverage manufacturing, biodiesel production, and integrated biorefineries, as well as other industries such as pulp and paper, forest products, and pharmaceuticals Biogas derived from any of the above feedstock streams, including but not limited to landfill gas. Beyond its interest in these traditional organic waste streams, BETO is interested in promoting novel, non-photosynthetic carbon-cycling strategies that would support the valorization of inorganic carbon oxides, such as carbon dioxide and carbon monoxide, found in industrial gaseous waste emissions and biogas. In general, BETO's efforts aim to improve waste-stream management by closing waste loops and generating additional value streams from waste.PRODUCTION POTENTIALDrawing on the workshops listed below, BETO published a report in January 2017, titled Biofuels and Bioproducts from Wet and Gaseous Waste Streams: Challenges and Opportunities. The report found that the United States has the potential to use 77 million dry tons of wet waste per year, which would generate about 1.079 quadrillion British thermal units (Btu) of energy. Gaseous feedstocks (which cannot be "dried" and therefore cannot be reported in dry tons) and other feedstocks assessed in the report could produce an additional 1,260 trillion Btu of energy, bringing the total to more than 2.3 quadrillion Btu annually. For perspective, in 2015 the United States' total primary energy consumption was about 97.7 quadrillion Btu.CONVERSION OF WASTE STREAMSWastes present a unique set of challenges in terms of conversion processes, and BETO has identified and is exploring a number of conversion possibilities at a range of technology-readiness levels.Hydrothermal ProcessingOne technology option BETO is considering is hydrothermal processing. Efforts to advance this technology have benefited from prior funding under BETO's algae and conversion research and development platforms. Research indicates that hydrothermal processing and related technologies could process diverse blends of wet waste feedstocks, offering potential for widespread deployment. For example, the Pacific Northwest National Laboratory has successfully produced a diesel blendstock from municipal sludge, and larger scale pilot efforts are under way. The hydrothermal research efforts so far represent only a few of the possibilities in this area. Supercritical water also offers intriguing options, as do other fluids at high temperature and pressure, such as carbon dioxide. Alternatives to Traditional Anaerobic DigestionAnaerobic digestion (AD) has been widely deployed worldwide as a part of waste treatment for sewage, animal manure, and other organic wastes. It produces biogas, primarily comprised of carbon dioxide and methane, which can be combusted to produce both heat and electricity. However, AD only reduces waste volumes by roughly 50%, and the biogas requires substantial (and costly) cleanup before it can be used as a vehicle fuel or injected into natural gas pipelines. Also, it is capital-intensive, and therefore uneconomic at smaller scales.In addition to hydrothermal processing, which could conceivably replace AD, BETO is exploring several alternatives to traditional AD. AD is a multi-step biological process. By arresting the final stage, it is possible to produce higher-value precursors to bioproducts and liquid biofuels rather than biogas. Alternative reactor designs, such as anaerobic membrane bioreactors, have the potential to reduce capital costs dramatically, and possibly to produce biogas with substantially more methane. There are also several promising possibilities to use both the carbon dioxide and the methane from biogas to produce higher-value fuels and products.SMALL BUSINESS INNOVATION RESEARCH OPPORTUNITIESBETO is exploring a broad range of possibilities to identify small businesses with early-stage technologies that qualify for DOE's Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs, which increase U.S. private-sector research on innovations to build a strong national economy. The early-stage nature of many waste-to-energy technologies, and the observation that the waste feedstock is readily available in many cases makes them good candidates for the SBIR/STTR programs. SBIR/STTR technical topic areas for both the Fiscal Year 2016 (topics 10 b and c) and Fiscal Year 2017 (topics 14 a and b) included aspects of waste to energy.WORKSHOPSBETO regularly hosts workshops and listening days to enhance its portfolio and engage key stakeholders in discussion. These workshops seek to integrate the activities of federal agencies to address research that is relevant to industry but which is appropriate to the unique role of government.Advancing the Bioeconomy: From Waste to Conversion-Ready Feedstocks Workshop: February 19–20, 2020In recent years, BETO has expanded its portfolio beyond traditional biomass feedstocks to include using waste resources, such as municipal solid waste (MSW), biosolids from municipal wastewater, and industrial waste gases. BETO conducted a workshop to understand the current state and potential trajectories of technologies to support MSW as a feedstock for producing fuels, value-added products, and power. Engineered Carbon Reduction Listening Day: July 8, 2017The purpose of this listening day was to understand how the novel concept of engineered carbon reduction could potentially rewire the bioeconomy. Engineered carbon reduction proposes solutions for challenges in the carbon capture and grid modernization sectors. Non-photosynthetic conversion technologies could—by leveraging excess or inexpensive energy when available—chemically reduce the carbon in waste carbon dioxide to intermediates. The intermediates could be further upgraded to fuels and products. Non-photosynthetic technologies discussed included both biological and non-biological approaches. Overarching themes of carbon efficiency and management, techno-economic analysis, life-cycle analysis, and supply chain sustainability analysis were also discussed.Biofuels and Bioproducts from Wet and Gaseous Waste Streams: Market Barriers and Opportunities Workshop: June 6–7, 2017 This meeting had a strong pragmatic emphasis, with a focus on tangible challenges and potential solutions in facilitating cost-effective technologies in the waste-to-energy platform. Participants included feedstock providers, technology developers, potential customers, and relevant state actors. Participants told BETO that increased communication across federal and local levels was encouraging, because waste-to-energy research and development should not live in a vacuum without regional considerations. Participants explained that waste feedstock characteristics are regionally unique, and waste management decisions are driven by state and municipal policy.Waste-to-Energy Roadmap Review: June 22–23, 2016This meeting provided an opportunity for key stakeholders to provide focused input on future challenges, opportunities, and possible strategies regarding the conversion of wet and gaseous waste streams into drop-in biofuels and bioproducts. Participants received a preliminary draft of the "Challenges and Opportunities" report in advance in order to inform discussion.Biogas Opportunities Roadmap Progress Report: December 2015The U.S. Department of Agriculture (USDA), U.S. Environmental Protection Agency (EPA), and DOE collaborated to update the Biogas Opportunities Roadmap. This effort extends the scope beyond the municipal wastewater community to include other relevant feedstocks, such as animal husbandry wastes. A key theme is that early opportunities may lie in feedstocks that currently pose disposal costs and challenges.Energy-Positive Water Resource Recovery Workshop: April 28–29, 2015 The National Science Foundation, DOE, and EPA jointly hosted this workshop to better define the industry's long-term vision (20+ years) for water resource-recovery facilities and the actions needed to make that vision a reality.Hydrogen, Hydrocarbons, and Bioproduct Precursors from Wastewaters Workshop: March 18–19, 2015 Hosted by BETO and DOE's Fuel Cell Technologies Office, this workshop focused on anaerobic membrane bioreactors and microbial electrochemical fuel cells. Approximately 40 attendees discussed the topics over two days, identifying ways to advance the sustainable utilization of wet waste streams, complement the work of other agencies, and maximize the value of research investment.Waste-to-Energy Workshop: November 5–6, 2014 Hosted by BETO, this workshop focused on AD, hydrothermal liquefaction, and other technologies for the production of energy products beyond biogas. Approximately 85 attendees identified 17 key ideas, including alternative reactor designs—which prompted further discussions and, ultimately, the follow-on workshop below. EPA Nutrient Recycling Challenge: Launched 2015 (Ongoing) In collaboration with USDA, private stakeholders, and DOE, EPA launched the Nutrient Recycling Challenge, focused initially on recovering nutrients from dairy and swine manure. Phase I awarded four primary and six secondary prizes and encouraged multiple additional applicants to move on to subsequent phases. KEY PUBLICATIONS-Back to Top-

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